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# Modelling driven pile installation in chalk for offshore renewables

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## Summary

Offshore wind and marine renewable energy are rapidly increasing worldwide, with a clear trend towards deep waters and harsher marine environments. This poses significant engineering challenges, including the design of support structures and foundations. It is shown how advanced numerical modelling can guide the design of the foundations in chalk.

## Abstract

Driven piles provide the most common foundation system for fixed oil and gas production platforms [1]. They are also employed in deep-water applications including tension leg platforms. Monopile foundations are currently supporting about 80% of offshore wind turbines in Europe.

Like for any other foundation type in sand, the capacity and deformability of the foundation depends on the stress state of the corresponding soil. Despite the improvements achieved by the most recent design codes [2,3], the stress profile around the shaft is often based on empirical correlations. These are even more unreliable when dealing with complex soil profiles such as crushable calcareous sands, porous collapsible structured clays or weak soft rocks such as chalk.

For marine renewable energy (MRE) structures foundations make up  $\approx 20\%$  of total cost, so improved geotechnical solutions can reduce cost. Chalk is present in a large area of the East and South coast of the UK where renewables are now being installed. In most cases they are founded on driven piles, whose design uses empirical methods or partial (wished-in-place) simulations based upon geotechnical information obtained before installation. Installation effects such as grain crushing and pore pressure generation are conservatively estimated (if considered at all), as the change of chalk properties around the pile due to pile installation cannot be easily quantified.

This research shows how advanced numerical modelling can be used to guide the design of the foundations in these complex soils. The coupled hydro-mechanical dynamic installation effects of pile driving in Chalks is addressed numerically using a recently developed constitutive model for chalks implemented into the Geotechnical Particle Finite Element Method (GPFEM) [4]. The GPFEM, capable of handling fast dynamic soil-structure interaction, will allow numerical simulation of the pile-driving problem. The numerical results will be used to critically address the limitation of current design specifications of driven piles in Chalk.

## References

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